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AUTONOMIC BROKERING FOR MINIMIZATION OF SERVICE LEVEL AGREEMENT VIOLATIONS IN CLOUD COMPUTING

MANPREET KAUR[1], JASPREET KAUR[2] & SAHIL VASHIST[3]

[1, 2]Research Scholar, Department of Computer Science Engineering, Chandigarh Engineering College, Mohali, Punjab, India

[3]Assistant Professor, Department of Computer Science Engineering, Chandigarh Engineering College, Mohali, Punjab, India

ABSTRACT

Cloud computing is emerging as a vital player in the field of information technology. Brokering in cloud computing is the main issue as with the emergence of cost effectiveness and managing virtual machines in cloud, cloud broker is an important entity to tackle. Therefore in this research paper, we bring these parameters together and create an economical broker framework. Brokering in cloud computing is considered to be a challenging job when multiple parameters are taken into consideration. Different scheduling strategies, monitoring results of virtual machine etc. are the different things that need to be catered by cloud broker. However maximization of revenue is main but difficult job. In this research work, we develop a framework which generates best mapping between virtual machine and request. We proposed Genetic Algorithm to minimize SLA violations. The results are compared against financial brokerage model in which broker uses to reserve instances based on historical records and earns profit. Simulation result using CloudSim simulator shows the effectiveness of our scheme.

KEYWORDS: Scheduling, Broker, Revenue, Virtual Machine, SLA Violations

INTRODUCTION

Cloud computing is an Internet based computing which delivers the shared computing resources to cloud service consumers on-demand, at any time, and anywhere. The cloud users do not need to own the resources, they just connect to the server via internet and access the available resources as a metered service. Instead of keeping data in house, the cloud consumers can take advantage of cloud services [18].The cloud services include online file storage, Social networking sites, Web mail, online business applications, and Computer processing power [7]. Cloud Computing is the most promising current implementation of Utility Computing in the business world, because it provides some key features over classic utility computing, such as elasticity to allow clients dynamically scale-up and scale down the resources in execution time, or the possibility of customizing completely the software environment by acquiring administrator rights without putting in risk the whole system [13].

Each cloud service vendors is aimed to sell their services at higher prices for generating maximum profit. But, clients have the opportunity to choose the cheapest vendor for same or better QOS option. Clients can select vendors according to their demand requirements. Service vendors can raise their prices when there is spike in demand and decrease prices when the demand is very low. The actual price that the user pays for the service is called Exercise Price.

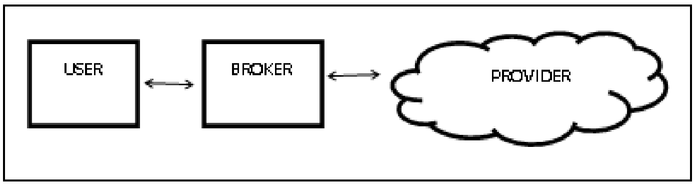

Figure 1: Broker Acts As an Interface between User and Cloud Provider

Cloud service brokerage plays an important role in cloud computing [11]. Cloud service brokerage provides an efficient way to consume and maintain cloud services for an organization in case when there are large number of cloud service providers. In cloud computing, cloud service brokerage is also defined as the single largest revenue generation opportunity. As shown in figure 1. Cloud broker provides an interface between user and providers.

A cloud broker is a software application that simplifies the distribution of work among different cloud service providers. This type of cloud broker is also known as cloud agent. A cloud broker negotiates service provisioning, pricing, delivery, migration and deployment details with a cloud provider on behalf of customer. Broker acts as an interface to match vendor's supplies with user requirements and offers most suitable match in terms of better SLA. A negotiation process begins to establish the terms of the contract. When both parties reach an agreement, the terms of the contract are specified in a Service Level Agreement (SLA) and the Client can use services under SLA options. Broker can profit in number of ways but in this research work, broker's focus is to minimize SLA violations and generate revenue [15].

RELATED WORK

Wu et al. [21] [22] presented truth telling reservation mechanism for resource reservation. This mechanism is named as WZH model. It consists of option contracts whose pricing structure encourages users to tell their true likelihoods that they will purchase this amount of resources in future. This helps the provider to make plan or reserve enough resources to avoid the risk of under-utilization and over booking. Truth telling mechanism is profitable for provider because demand is known in advance. And also for users as they can save additional cost for on-demand resources. WZH model uses third party entity as coordinators, which helps the providers for forecast of future resource demand and provide services to users at reduced price. Thus makes profit from both the parties. Rogers et al. [5][17] introduced financial brokerage model as a pricing model for cloud computing.

Financial brokerage model is an extension to WZH model. WZH model is based on theoretical concepts, so it was difficult to implement practically in real life. The proposed model was implemented using real world economic demand data, probability submitted by user based on historical demand data, current cost of AWS (Amazon Web Service) cloud instance. It was concluded that broker profits by reserving resources for longer term using past demand data. The advantage of this model is that forecast of future resource demand helps to plan future capacity requirement and performance is improved which targets to meet service level agreement requirement. Broker increases profits by 36%, when considering past performance for making resource reservation. Profit increases up to 33%, when reserving resources for three years instead of reserving for one year. By considering past performance and investing for long term resource reservation, broker profits up to 44% for same market scenarios. Clamp et al. [6] presented an adaptive brokerage model for cloud computing which is an extension and replication to Rogers and cliff (R & C) brokerage model. CReST (Cloud research simulation toolkit) simulation platform was used to evaluate the functioning of adaptive brokerage model. R&C's brokerage model was sensitive to certain parameters that require priori knowledge of market demand and other parameters

such as pricing tariff providers charge for resources, the price broker charge to clients and effect of noise on market demand profile. Adaptive brokerage model uses AAT (automated adaptive threshold) that enable the broker to automatically maximize profit under a variety of market conditions. Buyya et al. [1] [2], described cloud computing as a model for delivering cloud services similar to utilities such as electricity, telephony, gas and water to clients without regard to where these services reside. Caron et al. [4] presented an approach for forecasting cloud computing on demand resources. As cloud computing provides on-demand resource by automatically scale up and down feature using pay as you go model. To provide efficient resources scaling, an approach is used to predict the current and future demand for resources based on the past records. An algorithm, Cloud client resource auto scaling is used to make scaling decisions. Evaluation of proposed approach presents the usefulness and potential for auto scaling cloud resources. Le et al. [12] proposed a new benchmark framework to compare and evaluate brokers for cloud services. As cloud computing promises to deliver cost effective services to users, which further points toward challenges in brokering between cloud service providers and cloud service consumers. The proposed benchmark is called cloud broker challenge (CBC) which describes cloud service providers and cloud service consumer's complexities and is used for fair evaluation and comparison of cloud brokers. Hossain et al. [9] proposed a unique technique that increases customer satisfaction and decreases cloud service providers worry for continuing the business.

However the existing pricing model [16] can make certain customers dissatisfied. Thus there are immense chances to lose those dis-satisfied customers. The proposed technique is known as refundable services through cloud brokerage. Refundable service technique allows cloud consumers to refund unutilized services only. Unutilized services consist of those services that are degrading quality of service (QOS) by violating service level agreement (SLA) or that lack fairness in pricing. A third party entity called cloud broker [19] is used to handle all of the business instead of provider, thus reducing cloud service providers headache. Therefore from the related work it is evident that the brokerage techniques needs to be revisit and existing framework needs a complete overhauling. In this paper we have proposed a framework which has used genetic modeling[14]to counter these issues.

SYSTEM MODEL

In the proposed framework we have used the genetic algorithm for the processing of the requests. Each request is breakdown into selection phase and recombination phase as it occurs in genetic algorithms. As shown in the figure 2 requests being assigned into adjacent virtual machine during selection. We first believe the building of current request-virtual machine crossover as an initial population. This selection of cross-over is purely based on the fitness test where each requests is designated by fitness (size, cost) and virtual machine is also allotted correspondingly. After first phase of selection, genetic algorithm moves towards second phase of selection where recombination can occur. This happens after finding the results from first phase of selection and next crossover is getting ready for other intermediate population as shown in figure 2:

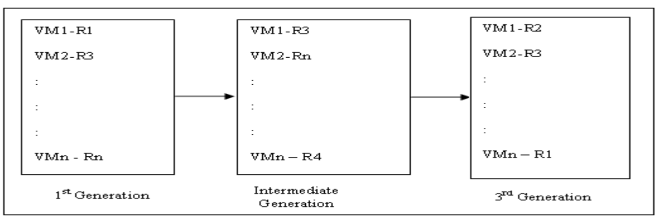

Figure 2: Evolution of VM-Requests Pairing

It has also been explained that the virtual machines crossover is being shifted from basic to intermediate and intermediate to 3rd generation. In third generation, the refined pairs are evolved in which for future similar type of requests are pair with it accordingly.

Following steps of genetic Algorithm has been used to carry out this research work:

Genetic Algorithm for Broker works in the following manner:

1. Begin
2. Initialize workload by random solutions.
3. Evaluate each request in terms of workload and cost.
4. Repeat until termination condition occurs.
5. Do
6. Select Virtual machines
7. Recombine pairs of virtual machines and requests.
8. Mutate the resulting offspring and add new VM to free pool if required.
9. Evaluate new candidate.
10. Select individuals for next generation
11. End

Figure 3: Steps for Genetic Algorithm

SIMULATION SETUP

In this research work, we have used cloudsim [3] as a simulator to implement our algorithm. Following is the configuration details of virtual machines, data centers and cloudlets shown in table 1 and table 2. Cloudlet and Datacenter Broker classes are extended for the simulation. Each datacenter has two hosts and each host has fifty virtual machines that mean each datacenter has 100 virtual machines. Xen hypervisor is used for virtual machine management.

Table 1: Configuration Detail for Virtual Machines

VM (Type)	Cost ($/Request)	Pes No	File Size	O/P Size
1	20	4	10000	10000
2	30	2	12000	12000
3	25	4	9000	10000

Table 2: Configuration Detail for Datacenter, Virtual Machines and Host

Datacenter (Name)	Number of Virtual Machines per Host	Number of Hosts	Hyper-Visor
DC_0	50	2	Xen
DC_1	50	2	Xen
DC_2	50	2	Xen
DC_3	50	2	Xen
DC_4	50	2	Xen
DC_5	50	2	Xen
DC_6	50	2	Xen
DC_7	50	2	Xen
DC_8	50	2	Xen
DC_9	50	2	Xen
DC_10	50	2	Xen

EXPERIMENTAL RESULTS

SLA violations and cost for virtual machines are two simulation parameters used in this research work as shown in table 3

Table 3: Comparative Results of System Model with and Without Genetic Approach for Cost and SLA Violation

No. of Cloudlets	Without Genetic Approach		With Genetic Approach	
	SLA Violations	Cost ($)	SLA Violations	Cost ($)
5000	0	0.6	0	0.6
5500	1	0.8	1	1
6000	1	0.9	0	0.8

Further we compare with other brokering techniques which use historical analysis for pairing. In figure 4, the graph along x-axis, represents the response time to process requests in milliseconds and y-axis, represents percentage of requests processed corresponding to time.

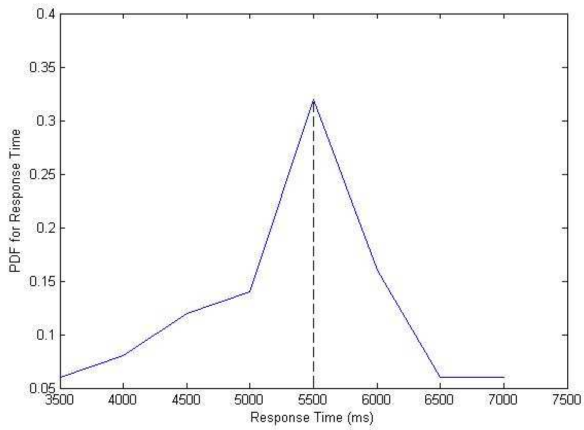

Figure 4: PDF of Response Time

If we move towards comparisons we can see that Genetic algorithm does not allow the SLA violation to cross the limit but in base paper the SLA violations are linearly increasing. In figure 5, up to 5000 requests, broker is generating profit with SLAs. At peak load, when number of requests received is 5500 at time‘t’, SLA violation (in terms of cost) occurs. In base brokering, SLA violations are linearly increasing with increase in number of requests after peak load i.e. after 5000 requests. This is clear from the graph that SLA violation for 6000 requests is greater than 5500 requests. Autonomic service brokering (proposed framework) using Genetic algorithm [8] is implemented to minimize SLA violations that is for 5500 requests when SLA violation occurs, intermediate (recombination) phase takes place to cross over virtual machine-request mapping.

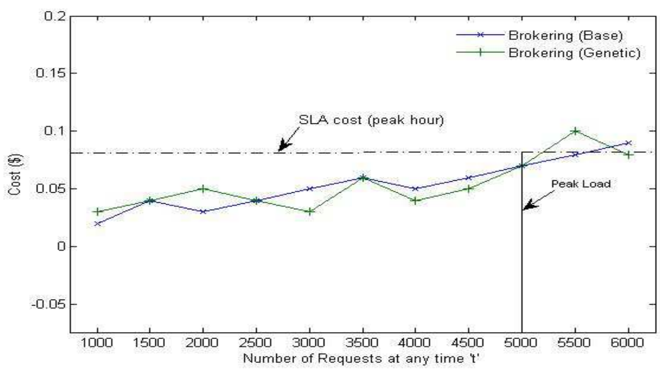

Figure 5: Comparison between Genetic Brokering and Base Brokering

After intermediate phase, SLA violation is minimized and is clear from graph that for 6000 requests SLA violations are reduced and so on. In base brokering, no action was taken to eliminate SLA violation. In proposed framework, broker is generating profit by minimizing SLA violation instead of historical analysis of demand that is done in base paper.

CONCLUSIONS AND FUTURE SCOPE

In this work, we have found that SLA violations play an important role in the revenue loss of a cloud service provider. Implementing a decision making process which can generate a correct SLA and management of the agreement is done by using genetic algorithm in this paper. Also a detail analysis of how genetic algorithm can be helpful in minimization of SLA violations is proposed. In this work we have analyzed that up to 3rd generation the pairing is successfully controlling the violation by finding the best pairs. But if we increase the generation level how much overhead can occur is also a nature of concern and will be our future work. Therefore in future work we will focus on how many generations are required to minimize the effect of SLA violations.

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